G97 Initial Studies Into Effects of Moderate Heat on Soft Tissue and Bone

Karl Harrison, PhD, Cranfield University, Defence Academy of the United Kingdom, Shrivenham, SN6 8LA, UNITED KINGDOM; and Brooke L. Webster, MSc, and Victoria Martin, MSc, Cranfield University, Shrivenham, SN6 8LA, UNITED KINGDOM*

After attending this presentation, attendees will acquire valuable incite into the response of soft tissues, specifically brain tissue, to relatively low temperatures that may dominate in protected areas within modern compartment fires. They will observe that these soft tissues can be preserved through carbonization while still maintaining a degree of chemical structure therefore viable for use in further forensic analysis, e.g. tissue identification, PMI, etc. This research also describes the application of modern fire techniques being used in an archaeological setting.

This presentation will impact the forensic science community by providing proven information that brain tissue can maintain chemical structure after visual carbonization of the material has occurred, it is evident that these types of samples are viable for use in further forensic research into the reaction of postmortem human remains to a burning event. This method of preservation can also potentially impact future archaeological methods of analysis when dealing with burned human remains.

This study uses evidence from the archaeological record to initiate experimental observations of the behaviour of brain tissue when exposed to moderate temperatures that might be expected at a low level within a modern compartment fire. The site of Çatalhöyük in central Turkey preserves remains of an extensive Neolithic settlement that has been noted for the preservation of the remains of burnt buildings, beneath some of which have been found the graves of buried individuals.

In one such burnt structure on the site, five sets of remains have exhibited evidence of intense carbonization, caused by heating in a reduced atmosphere whilst the remains were buried. The remains of each individual showed varying levels of carbonisation to their skeletal structure along with revealing carbonised organic material within their crania that is thought to be charred yet preserved brain tissue. The assumption is that radiating heat from the burning of the overlying structure has caused these changes; however, the complete image of this burning event and the correlation between it and the condition of the remains is not yet fully understood.

The studies discussed here have attempted to model and recreate the burning event and its effects on the buried remains by using forensic fire investigation techniques to analyze the thermal characteristics of the building materials of the settlement and comment on the amount of fuel and duration of burning that the characteristics of thermal alteration might suggest. If it can be proved analytically that the carbonised organic material is brain tissue it could potentially be the oldest surviving human brain material yet identified, as well being one of the few subject to such a peculiar means of stabilization.

Studies conducted on skull fragments from the remains indicate the skull reached temperatures of less than, or equal to, 500°C and were exposed to this heat for an extended period of time. No existing research was found that considered the effects of such relatively low temperatures and it is generally assumed that brain tissue would not survive this, or any type, of burning event. Experimental burning of porcine brain material, coupled with the use of micro-CT and FTIR analysis, were used to assess the capacity of brain tissue to carbonise at these temperatures over different durations of time and attempt to identify any remaining chemistry within the sample after this exposure.

The results of this work have not only succeeded in using the techniques of fire investigation to quantify the thermal energy required to create the necessary conditions to carbonise buried human remains, but in addition analysis of the preserved brain tissue has revealed preserved organic traces still present. This work not only demonstrates the adaptation of forensic techniques for archaeological applications, but also provides a valuable insight into the response of soft tissues to the relatively low temperatures that may dominate in protected areas within modern compartment fires.

Fire, Brain, Human Remains

 ** Presenting Author*